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September 2, 2004

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Art Unit 1623

Commissioner for Patents
PO Box 1450
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Re: U.S. Utility Patent Application
Application No. 09/967,184; Filed: September 28, 2001
For: Method for Recovering Products
Inventors: HEIKKILÄ *et al.*
Our Ref: 1427.0120000/MAC/THN

Sir:

Transmitted herewith for appropriate action are the following documents:

1. Fee Transmittal Form (PTO/SB/17);
2. Notice of Appeal From the Examiner to the Board of Patent Appeals and Interferences – Large Entity;
3. Amendment and Reply Under 37 C.F.R. § 1.116;
4. Credit Card Payment Form (PTO-2038) in the amount of \$330.00 to cover the Notice of Appeal fee (37 C.F.R. § 1.17(b)); and
5. One (1) return postcard.

It is respectfully requested that the attached postcard be stamped with the date of filing of these documents, and that it be returned to our courier. In the event that extensions of time are necessary to prevent abandonment of this patent application, then such extensions of time are hereby petitioned.

Commissioner for Patents
September 2, 2004
Page 2

The U.S. Patent and Trademark Office is hereby authorized to charge any fee deficiency,
or credit any overpayment, to our Deposit Account No. 19-0036.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

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Enclosures

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**Amendment Under 37 C.F.R. § 1.116
Expedited Procedure – Art Unit 1623**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

HEIKKILÄ *et al.*

Appl. No.: 09/967,184

Filed: September 28, 2001

For: Method for Recovering Products

Confirmation No.: 5971

Art Unit: 1623

Examiner: McIntosh III, Traviss C.

Atty. Docket: 1427.0120000/MAC/THN

Amendment and Reply Under 37 C.F.R. § 1.116

Mail Stop AF

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Sir:

In reply to the Office Action dated June 2, 2004, Applicants submit the following Amendment and Remarks. This Amendment is provided in the following format:

- (A) Each section begins on a separate sheet;
- (B) Starting on a separate sheet, amendments to the specification by presenting replacement paragraphs marked up to show changes made;
- (C) Starting on a separate sheet, a complete listing of all of the claims:
 - in ascending order;
 - with status identifiers; and
 - with markings in the currently amended claims;

- (D) Starting on a separate sheet, the Remarks.

It is not believed that extensions of time or fees for net addition of claims are required beyond those that may otherwise be provided for in documents accompanying this paper. However, if additional extensions of time are necessary to prevent

HEIKKILÄ *et al.*
Appl. No. 09/967,184

abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. § 1.136(a), and any fees required therefor (including fees for net addition of claims) are hereby authorized to be charged to our Deposit Account No. 19-0036.

Amendments to the Claims

The listing of claims will replace all prior versions, and listings of claims in the application.

1. (currently amended) A method, comprising a multistep process for recovering one or more monosaccharides from a feed solution containing rhamnose and at least two one monosaccharides monosaccharide selected from the group consisting of rhamnose, arabinose, xylose and mixtures thereof by using chromatographic separation comprising at least one step, where a weak acid cation exchange resin is used for the said chromatographic separation so as to obtain a rhamnose rich fraction and recover rhamnose from the feed solution.

2. (currently amended) The method of claim 1, comprising feeding the feed solution to a chromatographic column containing a weak acid cation exchange resin, eluting said chromatographic column with an eluant, and separating and recovering [[a]] the rhamnose rich fraction

3. (currently amended) The method of claim 1, wherein a strong acid cation exchange resin is further used for the chromatographic separation.

4. (currently amended) The method of claim 1, wherein the multistep process further comprises steps selected from the group consisting of crystallization, filtration, evaporation, precipitation and ion exchange.

5. (canceled)

6. (currently amended) The method of claim [[5]] 1, wherein the rhamnose

recovered is L-rhamnose.

7. (currently amended) The method of claim [[5]] 1, wherein the feed solution is a xylose process stream or side stream.

8. (currently amended) The method of claim [[5]] 1, wherein an arabinose rich fraction is further separated and recovered from the feed solution.

9. (currently amended) The method of claim 8, wherein the arabinose to be recovered is L-arabinose.

10. (currently amended) The method of claim [[5]] 1, wherein a xylose rich fraction is further separated and recovered from the feed solution.

11. (currently amended) The method of claim 10, wherein the xylose to be recovered is D-xylose.

12. (currently amended) The method of claim 1, wherein the weak acid cation exchange resin is an acrylic resin.

13. (currently amended) The method of claim 12, wherein the acrylic resin is derived from the group consisting of methyl acrylate, ethyl acrylate, butyl acrylate, methyl methacrylate, acrylonitrile, acrylic acids and mixtures thereof.

14. (currently amended) The method of claim 12, wherein the cation of said weak acid cation exchange resin is in the form selected from the group consisting of Na^+ , Mg^{2+} , H^+ and Ca^{2+} .

15. (currently amended) The method of claim 14, wherein the cation of said weak acid cation exchange resin is in Na⁺ form.

16. (currently amended) The method of claim 12, wherein the resin is crosslinked with divinyl benzene (DVB).

17. (currently amended) The method of claim 16, wherein the crosslinking degree of the resin is 3 to 8 % by weight.

18. (currently amended) The method of claim 2, wherein the eluant is water.

19. (currently amended) The method of claim 1, comprising feeding the feed solution to a first chromatographic column and then feeding a fraction of the outgoing solution from the first chromatographic column to a second chromatographic column, both columns containing a weak acid cation exchange resin.

20. (currently amended) The method of claim 19, comprising feeding a fraction of the outgoing solution from the second chromatographic column to a third chromatographic column containing a strong acid cation exchange resin and feeding a fraction of the outgoing solution from the third chromatographic column to a fourth chromatographic column containing strong acid cation exchange resin.

21. (currently amended) The method of claim 1, comprising feeding the feed solution to a first chromatographic column containing a strong acid cation exchange resin and then feeding a fraction of the outgoing solution from the first chromatographic column to a second chromatographic column containing a weak acid

cation exchange resin.

22. (currently amended) The method of claim 21, comprising feeding a fraction of the outgoing solution from the second chromatographic column to a third chromatographic column containing a weak acid cation exchange resin.

23. (currently amended) The method of claim 19, comprising feeding a fraction of the outgoing solution from the second chromatographic column to a third chromatographic column containing a strong acid cation exchange resin.

24. (currently amended) The method of claim 21, comprising feeding a fraction of the outgoing solution from the second chromatographic column to a third chromatographic column containing a strong acid cation exchange resin.

25. (currently amended) The method of claim 19, wherein prior to feeding the fraction of the outgoing solution to the next chromatographic column said fraction is concentrated by evaporation.

26. (currently amended) The method of claim 21, wherein prior to feeding the fraction of the outgoing solution to the next chromatographic column said fraction is concentrated by evaporation.

27. (currently amended) The method of claim 2, wherein the temperature of the eluant is between from 10 °C and to 95 °C.

28. (currently amended) The method of claim 27, wherein the temperature of the eluant is between from 55 °C and to 85 °C.

29. (currently amended) The method of claim 1, wherein the particle size of the weak acid cation exchange resin is 10 to 2000 µm.

30. (currently amended) The method of claim 29, wherein the particle size of the weak acid cation exchange resin is 100 to 400 µm.

31. (currently amended) The method of claim 1, wherein the pH of a feed solution is 1 to 10.

32. (currently amended) The method of claim 31, wherein the pH of the feed solution is 2 to 4.

33. (currently amended) The method of claim 31, wherein the pH of the feed solution is 5 to 10.

34. (currently amended) The method of claim 19, comprising recovering xylose and arabinose from both the first and the second chromatographic column.

35. (currently amended) The method of claim 21, comprising recovering xylose and arabinose from both the first and the second chromatographic column.

36. (currently amended) The method of claim 8, comprising isolating arabinose of the arabinose rich fraction by crystallization.

37. (currently amended) The method of claim 20, comprising recovering rhamnose from the second and/or the third chromatographic column.

38. (currently amended) The method of claim 22, comprising recovering rhamnose from the second and/or the third chromatographic column.

39. (currently amended) The method of claim 6, comprising further isolating L-rhamnose by crystallization.

40. (currently amended) The method of claim 6, comprising isolating L-rhamnose in the form of monohydrate.

41. (currently amended) The method of claim 10, comprising isolating xylose of the xylose rich fraction by crystallization.

42. (currently amended) The method of claim 1, wherein the method is a batch process.

43. (currently amended) The method of claim 1, wherein ~~the feed solution includes rhamnose and a~~ the rhamnose fraction is collected before the other monosaccharides.

44. (currently amended) The method of claim 1, wherein ~~the feed solution includes rhamnose and a~~ the rhamnose fraction is collected after the other monosaccharides.

45. (currently amended) The method of claim 1, wherein the feed solution includes rhamnose and arabinose and both are collected together.

46. (currently amended) The method of claim 1, wherein the chromatographic separation method is a simulated moving bed system.

47. (currently amended) The method of claim 46, wherein the simulated moving bed system is sequential.

48. (currently amended) The method of claim 46, wherein the simulated moving bed system is continuous.

49. (currently amended) The method of claim 46, wherein at least one column or a part of a column contains a strong acid cation exchange resin and at least one column contains a weak acid cation exchange resin.

Remarks

Reconsideration of this Application is respectfully requested.

Applicants acknowledge with appreciation that the Examiner has withdrawn the rejections under 35 U.S.C. § 112, 2nd paragraph.

Applicants respectfully request that this Amendment under 37 C.F.R. § 1.116 be entered by the Examiner, placing claims 1-4 and 6-49 in condition for allowance or materially reducing the number of issues for appeal. Applicants submit that the proposed amendments of claims 1-4 and 6-49 do not raise new issues or necessitate the undertaking of any additional search of the art by the Examiner, since all the elements and their relationships claimed were earlier claimed.

Upon entry of the foregoing amendment, claims 1-4 and 6-49 are pending in the application, with claim 1 being the independent claim. Claims 1-4 and 6-49 are sought to be amended. Claim 5 is sought to be canceled without prejudice to or disclaimer of the subject matter therein, as being redundant in view of the amendments made to claim 1. These changes are believed to introduce no new matter, and their entry is respectfully requested. Applicants assert the right to file one or more continuing applications for the subject-matter canceled. Support for the amendments can be found in the original specification and claims as filed.

Claim 1 has been amended by requiring that the feed solution contains rhamnose and adding the following phrase at the end of the claim: "so as to obtain a rhamnose rich fraction and recover rhamnose from the feed solution". Support for the amendments in claim 1 is found in claims 2 and 5 and, *inter alia*, at page 10, lines 12-14 of the specification as originally filed. Claim 5 has been canceled as redundant. Claim 1 has

also been amended by changing "the" in front of the second occurrence of the phrase "chromatographic separation" into --said--. Also, a comma has been added after "A method" in the preamble of claim 1. No new matter has been added into claim 1 by the above amendments.

Claim 2 has been amended by replacing the article "a" with --the-- in front of "rhamnose rich fraction."

Claims 6, 7, 8, and 10 have been amended to make them dependent from claim 1 instead of the canceled claim 5. No new matter has been added by this amendment.

Claims 27 and 28 have been amended by defining the temperature ranges as described at page 7, lines 29 and 30 of the specification as originally filed. No new matter has been added by this amendment.

Claims 43 and 44 have been amended by deleting the phrase "the feed solution includes rhamnose and a" as redundant and adding --the-- before "rhamnose". No new matter has been added by these amendments.

Claims 2-4 and 6-49 have been amended by adding a comma after the claim number where these claims depend from.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Description of the Invention

As presently claimed, the present invention is directed to a method comprising a multistep process for recovering one or more monosaccharides from a feed solution containing rhamnose and at least one monosaccharide selected from the group consisting

of arabinose, xylose and mixtures thereof by using chromatographic separation comprising at least one step, where a weak acid cation exchange resin is used for the chromatographic separation to obtain a rhamnose rich fraction and recover rhamnose from the feed solution.

The separation of rhamnose from solutions containing rhamnose has been very difficult by known methods using, *e.g.*, strongly acid cation exchange resins (at page 10, lines 17-21 of the original specification). Applicants have surprisingly discovered that rhamnose can be effectively separated from carbohydrate streams by using weak acid cation exchange resins (at page 5, lines 11-13 of the original specification).

Rejections under 35 U.S.C. § 102

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). There must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. *Scripps Clinic v. Genentech, Inc.*, 18 U.S.P.Q.2d 1001, 1010 (Fed. Cir. 1991).

If the prior art does not necessarily function in accordance with, or does not include, the claimed limitations, it does not anticipate. *Mehl/Biophile International Corp. v. Milgram*, 52 U.S.P.Q.2d 1302 (Fed. Cir. 1999). In other words, "a limitation or the entire invention is inherent and in the public domain if it is the 'natural result flowing from' the explicit disclosure of the prior art." *Schering Corporation v. Geneva Pharmaceuticals, Inc. and Novartis Corporation et al.*, 68 U.S.P.Q.2d 1760 (Fed. Cir. 2003).

The Examiner has maintained the rejection of claims 1, 12-14, 16, 27-31, and 42 under 35 U.S.C. 102(a) as allegedly being anticipated by Heikkilä *et al.* (U.S. Pat. No. 5,998,607). Applicants respectfully traverse this rejection.

The Examiner refers to Example 11 of Heikkilä *et al.* which purportedly describes a chromatographic separation of a Mg-sulphite cooking liquor where a slightly acid cation exchange resin was used to separate a xylose fraction. According to Example 11, xylose and xylonic acid were eluted almost simultaneously. Heikkilä *et al.* is silent regarding a chromatographic separation to obtain a rhamnose rich fraction using a weak acid cation exchange resin to recover rhamnose. Heikkilä *et al.* do not even mention rhamnose. Further, it is respectfully submitted that a chromatographic separation to obtain a rhamnose rich fraction to recover rhamnose using a weak cation exchange resin is not a natural result flowing from the explicit disclosure of Heikkilä *et al.*

Claim 1 has been amended by incorporating into claim 1 the subject matter of claim 5 the Examiner has not rejected under 35 U.S.C. § 102(a). Accordingly, amended claim 1 requires that the multistep process for recovering one or more monosaccharides from a feed solution containing rhamnose and at least another monosaccharide by using chromatographic separation comprises at least one step where a weak cation exchange resin is used for the chromatographic separation to obtain a rhamnose rich fraction to recover rhamnose from the feed solution. Claim 1 as amended is not anticipated by Heikkilä *et al.* at least for the reason that the reference does neither disclose nor necessarily include the chromatographic separation to obtain a rhamnose rich fraction by using a weak cation exchange resin to recover rhamnose. It is respectfully submitted that Heikkilä *et al.* do not describe each and every element of the independent claim 1 as amended either expressly or inherently. Therefore, claim 1 is not anticipated by Heikkilä

et al. It follows that Heikkilä *et al.* do not anticipate any of the claims that are dependent from claim 1.

In view of the above, reconsideration and withdrawal of the rejection under 35 U.S.C. § 102(a) of claims 1, 12-14, 16, 27-31, and 42 are respectfully requested.

Rejections under 35 U.S.C. § 103

In determining the differences between the prior art and the claims, the question under 35 U.S.C. § 103 is not whether the differences *themselves* would have been obvious, but whether the claimed invention *as a whole* would have been obvious. See M.P.E.P. § 2141.02. Thus, *all* the limitations of a claim must be considered when weighing the differences between the claimed invention and the prior art in determining the obviousness of a process or a method claim. See M.P.E.P. § 2116.01. Furthermore, a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 U.S.P.Q. 303 (Fed. Cir. 1983), cert. denied, 469 U.S. 861 (1984).

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. See M.P.E.P. § 2143.

The Examiner has maintained the rejection of claims 1-6 and 8-49 under 35 U.S.C. 103(a) as allegedly being unpatentable over Heikkilä *et al.* (U.S. Pat. No. 5,998,607) in combination with Blaschek (*Journal of Chromatography* 256: 157-163 (1983)). The Examiner has also rejected claim 7 as allegedly being unpatentable over Heikkilä *et al.* in combination with Blaschek. Applicants respectfully traverse these rejections.

According to the Examiner, "Heikkila *et al.* disclose methods of separating xylose by using a slightly acidic cation exchange resin (example 11) . . . What is not taught by Heikkila *et al.* is to use multiple columns, the order of the various monosaccharides (rhamnose, xylose and arabinose) which are eluted, to use water as the eluant, to use the resin in the Na⁺ form, to concentrate the solution before transferring to the next column, to isolate the products by crystallization, or to use various simulated moving bed systems."

Further, the Examiner alleges that "Blaschek *et al.* teach methods of separating L-rhamnose, L-arabinose, D-xylose, D-mannose, D-galactose, and D-glucose by multiple chromatography runs using water as the eluent. Blaschek *et al.* teach that the various sugars are eluted from columns at different rates, and are eluted from different columns at different rates (Table 1)." Furthermore, the Examiner states that "Blaschek *et al.* show that an initial run will separate rhamnose from xylose and arabinose, and then an additional run on a different column will separate xylose and arabinose."

The Examiner alleges that

it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the weak acid cation exchange resin of Heikkila *et al.* to separate the various sugars, as Heikkila *et al.* teach the Purolite C 105™ column (which is a weak acid cation exchange resin) to be effective in separating a xylose containing fraction from a Mg-sulphite

cooking liquor and one would have been motivated to use this column as it is known to be effective in sugar separation and multiple columns are shown to be effective when separating multiple sugars.

Office Action at page 7, lines 1-7.

Applicants respectfully disagree. It is respectfully submitted that the Examiner has failed to establish *prima facie* case of obviousness. In particular, Heikkilä *et al.* do not teach or suggest, alone or in combination with Blaschek, all the claim limitations. Further, Heikkilä *et al.*, alone or in combination with Blaschek, do not provide any motivation for a person skilled in the art to use a weak acid cation exchange resin in a chromatographic separation to obtain a rhamnose rich fraction to recover rhamnose as claimed in claim 1 with a reasonable expectation of success. Furthermore, both Heikkilä *et al.* and Blaschek teach away from the present invention.

Applicants have discussed Heikkilä *et al.* above in regard to the 35 U.S.C. § 102(a) rejection. Accordingly, Applicants respectfully submit that Heikkilä *et al.* do not teach or suggest the chromatographic separation to obtain a rhamnose rich fraction by using a weak cation exchange resin to recover rhamnose from the feed solution as claimed in amended claim 1 and, therefore, do not teach or suggest all the claim limitations.

Further, Example 13 of Heikkilä *et al.* describe the chromatographic separation of Mg-sulphite cooking liquor where a strong acid cation exchange resin was used to separate xylose. The elution order was as follows: salts, xylose and xylonic acid. The xylose and the xylonic acid fractions overlapped partly. However, compared to the results of Example 11, where the xylose and xylonic acid fractions eluted almost simultaneously, the separation of xylose in Example 13 was slightly better. Heikkilä *et al.* also specifically claim the use of a strong acid cation exchange resin in the

chromatographic separation in claim 12 showing a preference for a strong acid cation exchange resin. Heikkilä *et al.* do not specifically claim the use of a weak acid cation exchange resin. In view of above, Heikkilä *et al.* do not provide any motivation for a person skilled in the art to use a weak acid cation exchange resin in a chromatographic separation to obtain a rhamnose rich fraction to recover rhamnose as claimed in claim 1 with a reasonable expectation of success. In fact, Heikkilä *et al.* teach away from using a weak acid cation exchange resin for separating monosaccharides.

Blaschek purportedly discloses the separation of L-rhamnose from a mixture of monosaccharides L-rhamnose, L-arabinose, D-xylose, D-mannose, D-galactose and D-glucose by HPLC using an amino-bonded phase, APS-Hypersil column. A person skilled in the art would recognize that an APS-Hypersil column, a silica based stationary phase having aminopropyl groups, is not a weak acid cation exchanger.

Blaschek also describes the attempt of using a strong acid cation exchange resin (Aminex HPX-87P) for separating the above mentioned mixture of monosaccharides. However, Blaschek describes that no satisfactory baseline separation of that mixture can be achieved by using the strong acid cation exchange resin.

In view of the above, Blaschek does not teach or suggest the use of a weak acid cation exchange resin for separating rhamnose from a mixture of monosaccharides. Further, Blaschek does not provide any motivation for a person skilled in the art to use a weak acid cation exchange resin in a chromatographic separation to obtain a rhamnose rich fraction to recover rhamnose as claimed in claim 1 with a reasonable expectation of success. In fact, Blaschek teaches away from the present invention. Blaschek does not remedy the deficiencies of Heikkilä *et al.*

The Examiner is correct that the present claims are also drawn to multiple runs with multiple columns in addition to one run in one column. Blaschek purportedly describes multiple runs in multiple columns for separating various monosaccharides. However, Blaschek does not describe, teach or suggest that at least one column contains a weak acid cation exchange resin for separating a rhamnose rich fraction from the mixture. Therefore a person skilled in the art would not have been motivated to use the weak acid action exchange resin of Heikkilä *et al.* in at least one column for a chromatographic separation to obtain a rhamnose rich fraction from a feed solution containing multiple monosaccharides as claimed in claim 1 with a reasonable expectation of success.

It is respectfully submitted that Heikkilä *et al.*, alone or in combination with Blaschek, do not render claim 1 as amended, or any claim dependent on claim 1, obvious. Therefore, reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) of claims 1-49 are respectfully requested.

Other Matters

The Examiner is hereby informed that the responsibility of the prosecution of the above-captioned application has been transferred to Sterne, Kessler, Goldstein & Fox P.L.L.C. at the address provided below. The new Attorney Docket No. is 1427.0120000/MAC/THN.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn.

In view of the foregoing remarks, Applicants submit that the claimed invention, as amended, is neither anticipated nor rendered obvious in view of the prior art references cited against this application. Applicants therefore request the entry of the Amendment, the Examiner's reconsideration and reexamination of the application, and the timely allowance of the pending claims.

Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.

Further, Applicants submit that the entry of the amendment would place the application in better form for appeal, should the Examiner dispute the patentability of the pending claims.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully
requested.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

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Date: September 2, 2004

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